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ABSTRACT

This investigation examined whether articulation problems represent a more pervasive linguistic or cognitive disability and whether a genetic component exists, by following up a longitudinal articulation study of 394 normally developing children begun in 1960. A group of 24 individuals, aged 31-33, who had participated in the original study and who had displayed at least moderate articulation problems which had not resolved by the end of first grade, were administered a battery of cognitive, linguistic, demographic, and environmental measures. Spouses and children over age three also completed the tests. Compared to a group of 28 controls, adult subjects produced significantly more residual articulation errors, showed poorer performance on a language test and a block design test, had completed fewer years of education, and were more likely to hold jobs in unskilled occupational classes. Children of subjects performed more poorly than control children on cognitive tasks, although offspring data were more variable than adult data and group differences were not as large. Children of subjects also received lower articulation scores, but exhibited skills considered to be age-appropriate, perhaps because a relatively large number of the children had received articulation intervention. Having a parent with a moderate articulation disorder in childhood appears to greatly increase offspring risk for speech and language disability. (JDD)

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A 28-Year Follow-up of Children with Phonological Disorders

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Recent estimates suggest that approximately 4% of all children in the preschool and elementary grades have a functional articulation disorder. Despite the large numbers of children who receive this diagnosis, the etiology and developmental course of this condition remain unknown, as do the long-term educational and occupational consequences for affected individuals.

In the past, it is been widely presumed that children who manifest phonological problems in their early years will not display speech production errors by adolescence, and will experience educational and occupational outcomes that are comparable to their unaffected peers. Recently, however, a growing body of literature has suggested that moderate articulation problems in children are associated with other learning disabilities. Further, there is increasing evidence that these disorders do not occur randomly in the population, but tend to cluster within families. Both of these observations have led some investigators within our field to consider the possibility that articulation problems may, in fact, represent one symptom of a more pervasive linguistic or cognitive disability, and that this underlying pathology may have a genetic component.

------figure 1------

The present investigation is a follow-up to a longitudinal articulation and academic study of 394 normally developing children begun in 1960 by Dr. Mildred Templin at the University of Minnesota. Because comprehensive developmental speech data are available for these subjects, the current study was able to address questions pertaining both to familiality of articulation disorders and to long-term consequences for affected individuals without the need for reliance upon self-reported retrospection of disability.

Participants in the Templin longitudinal project are now between 31 and 33 years of age, and most have families. From this original database, two groups of subjects were selected. These subjects, their spouse, and all of their children over age three were administered a battery of cognitive and linguistic tests, and demographic and environmental measures were collected.

The proband group was comprised of 24 individuals who displayed at least moderate articulation problems which had not resolved by the end of first grade. The control group consisted of 28 individuals who were average or better in articulation ability over the same period. It is important to emphasize that subjects were ascertained solely on the basis of childhood articulation performance. No other selection criteria were imposed.

Thus, the present study had two primary objectives:

-----figure 2-----

1) To obtain follow-up information on the adult status of individuals who were articulation impaired in childhood, by comparing their linguistic performance and educational and occupational attainment to individuals in the same birth cohort without articulation disability; and

2) To establish empirically the extent to which functional speech disorders aggregate in families, by comparing the linguistic performance of children who had a parent with a documented history of articulation disorder to children with a negative parental history of this condition.

Subjects were tested in one or two sessions in their homes, generally by two examiners. The examiner who was responsible for collecting data from the children was blind to the group status of the family she was visiting in all but a very few cases.

-----figure 3-----

Tests were selected to sample a broad range of linguistic and cognitive skills for both children and adults. Three primary domains were sampled: articulation, language, and nonverbal performance. These domains are briefly described in slide 3, along with a listing of the specific tests administered within each domain. Four subtests from the Wechsler Intelligence Test series were administered to all subjects who were at least four years of age. Two of these subtests, vocabulary and comprehension, were considered to be measures of language ability. The block design and picture completion subtests were selected as representative measures of nonverbal reasoning. The remaining tests were chosen to tap specific components of the linguistic system which are considered to be reflective of overall language functioning.

Articulation was assessed at all ages by different forms of the Templin Darley Test of Articulation. For younger children, the 50-item picture version of the Templin-Darley Screening Test was administered. For older children and adults, consonant production was sampled by having subjects orally read the first 78 sentences from the Templin Darley Sentence Articulation Test.

Since most of the individual tests are norm-referenced, performance was compared by converting the raw test scores into t-scores. For each subject, a composite score was derived for each domain by averaging the t-scores for the individual tests

within that domain. For ease of presentation, the mean, standard deviation, and effect size values that will be reported are based on these composites. In virtually all cases, the composite score is representative of the results found when examining the component tests individually.

This t-score conversion could not be done for the articulation scores of children over age nine and adults, since no norms exist on the Templin-Darley Test at these ages. In these cases, raw articulation scores were treated categorically, and were analyzed using the chi-square statistic.

-----figure 4-----

In the first analysis, the adult articulation performance of the proband and control subjects was compared. In late childhood and adulthood, virtual error-free performance in articulation is expected. Thus, in the present study, the 78-item articulation test administered to adults was considered to be either passed, defined as the production of less than 2 errors, or failed, defined as producing two or more errors. When viewed in this manner, the adult probands were judged to produce significantly more residual articulation errors than were the adult controls, with a failure rate among the probands of 50%, and a failure rate among controls of 4%.

-----figure 5-----

The differences between groups was even more robust for the domain of language. The F-value for the language domain was highly significant, and subsequent follow-up tests demonstrated that each of the component language tests contributed to this difference, with effect sizes for all three language tests exceeding one standard deviation.

In the domain of nonverbal performance, the F again reached significance. Follow-up t-tests revealed significant group differences for block design, but not for picture completion. This difference can be attributed more to above average performance by the controls than to deficit performance by the probands, since the probands, as a group, scored near the population mean in block design.

-----figure 6----

As part of the assessment, all adults completed an interview in which they responded to questions about educational and occupational attainment. As can be seen, the proband subjects, on average, completed fewer years of education than did the controls, although all of the subjects in both groups earned at least a high school equivalency degree. Nearly three-quarters of the proband subjects, however, did not pursue formal education beyond high school, while three-quarters of the control subjects completed at least one year of post-secondary education or training.

------figure 7-----

This outcome difference is also reflected occupationally. Using Hollingshead Four-Factor occupational categories, fifty percent of the probands were assigned to the unskilled occupational classes, in comparison to none of the controls. About half of the controls, 57%, held clerical, sales, or semiprofessional positions and 21% of the controls were considered major or minor professionals. In contrast, 8% of the probands were represented in the semiprofessional category, with only one proband achieving professional status.

It is interesting to note, however, that proband and control subjects did not differ in self-reported educational and occupational satisfaction. Asked if they were "very," "fairly," or "not" satisfied with their present occupation and the amount of education they had received, the majority of subjects in both groups indicated that they were "very" or "fairly" satisfied. Thus, although the proband subjects tended to be "lower achievers," most did not express overt dissatisfaction with these outcomes.

The test results for the offspring of proband and control subjects are highly comparable to results obtained from their parent. On average, the proband children performed more poorly than the control children on the cognitive tasks, although the offspring data tended to be more variable than the adult data, and the group differences were not quite as large.

-----figure 8-----

In the domain of articulation, the proband and control children were significantly different at all ages tested, with the children of probands receiving lower articulation scores. However, it should be noted that most of the proband children had articulation skills which would be considered age-appropriate. Within this group, there were a small number of children with markedly deviant articulation performance, and a much larger group of children with average or low-average pronunciation skills. Among the control children, performance in articulation was average or better for age in 86% of the cases, with the controls, as a group, scoring about a quarter of a standard deviation above the published norms on the Templin-Darley Test of Articulation.

One potentially confounding factor which may affect articulation scores is speech intervention. Information about the receipt of speech services among the offspring was obtained from parents in both groups. Of the 42 proband children in the present sample, 13 of them, or 31% had been or were currently receiving speech intervention, in all but one case for remediation of disordered articulation. In the control group, none of the 41 children had ever received speech services. In comparison to a population rate of 4% for the receipt of this service in elementary school, a positive treatment rate of 31% in the proband group must be considered highly substantial. The relatively large numbers of children in the proband group who

received articulation intervention may partially explain why so many of the proband children demonstrated articulation skills in the average range at the time of testing.

-----figure 9------

In the domain of language, the analysis again revealed significant group differences. Follow-up tests were significant for all tests except the Test of Auditory Comprehension of Language. This nonsignificant finding suggests that perhaps there is less involvement in language comprehension than in language expression among the offspring of probands, although this interpretation is at present still speculative.

In the domain of nonverbal reasoning, the proband children performed significantly more poorly than the control children on both of the Wechsler performance tests. As was observed in the adult sample, the proband children tended to score near the population average on the nonverbal subtests, while the control children performed about one half of a standard deviation above the population average on these measures. It is not clear why both the control adults and their children performed so well (on the block design subtest in particular), although it is interesting that a similar effect was observed in both cases.

-----figure 10------

Results of this investigation strongly support two conclusions. First, with respect to adult outcome, the present findings demonstrate residual deficits in language and articulation functioning among proband adults, both when compared to control adults and to the population at large. On language measures, proband adults score about one standard deviation below the population average, a difference which is of clinical as well as theoretical importance. This suggestion of residual deficit is supported by educational and occupational outcome data, which demonstrate that proband adults complete less formal education than control adults, and tend to occupy jobs which are considered nonprofessional, perhaps because they require less verbal proficiency.

Historically, an articulation impairment has been viewed by many as an isolated, developmental problem of limited prognostic importance. The current findings do not support this conceptualization. Rather, they suggest that the presence of a moderate articulation problem in childhood may in fact be predictive of long-term deficits in a broad range of linguistic abilities.

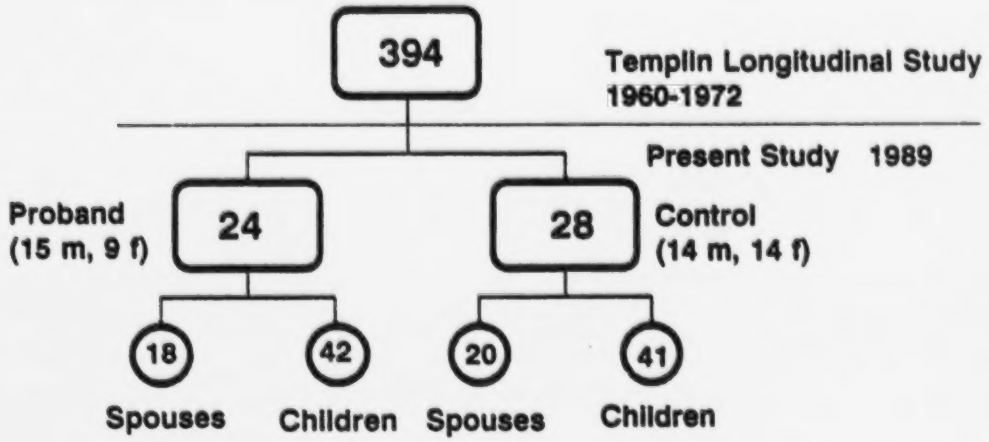
Secondly, the present results affirm the familiality of functional speech disorders, a phenomenon which has long been suspected and is now becoming empirically established. In this investigation, the offspring of proband subjects performed more poorly than the offspring of controls in all three of the domains

assessed, although the magnitude of their deficit was generally less extreme than that observed for the adult subjects. The pattern of performance, however, was highly similar for parents and their offspring, with the proband children performing relatively better on performance tasks, and poorest in the language domain.

These children are not, however, to be characterized as a generally intellectually or academically dysfunctional group. While proband children did tend to repeat kindergarten more often than control children, they did not receive significantly more remedial services in school, with the exception of speech therapy, where group differences were extremely large. This suggests a fair specificity of familial disability; that is, having a parent with a moderate articulation disorder in childhood appears to greatly increases offspring risk for speech and language disability in particular.

Figure 1

Sample Characteristics



Children of Probands: Age range 3-0 to 13-2, mean 7-8
Children of Controls: Age range 3-0 to 14-11, mean 6-8

Figure 2

Research Objectives

- To obtain follow-up information on the adult status of individuals who were articulation impaired in childhood.

- To establish empirically the extent to which functional speech disorders aggregate in families.

Figure 3

Assessment Domains

Language: comprehension and expression of vocabulary & grammar

- Peabody Picture Vocabulary Test (PPVT)
- Wechsler vocabulary subtest
- Wechsler comprehension subtest
- Test of Auditory Comprehension of Language (TACL)*
- ITPA - grammatic closure subtest*

Performance: nonverbal reasoning

- Wechsler block design subtest
- Wechsler picture completion subtest

Articulation: pronunciation of consonant sounds

- Templin-Darley Articulation Test (TDAT)
  - picture or sentence form

*administered only to children between 3 and 9 years

Figure 4

Test Results: Proband vs. Control Adults

Domain: Articulation

($X^2 = 14.86$, $p < .005$)

	N	Mean	SD	% Fail*
probands	24	73.17	6.15	50
controls	28	77.43	1.71	4

*fail = score of 76 or less on 78-item TDAT

Figure 5

Test Results: Proband vs. Control Adults

Domain: Language

(F = 12.30, p < .0001, effect size = 1.24)

	N	Mean T-score	SD
probands	24	40.22	7.93
controls	28	52.57	6.63

Domain: Performance

(F = 4.97, p = .01, effect size = .54)

	N	Mean T-score	SD
probands	24	47.36	7.55
controls	28	52.80	6.22

Figure 6

Outcome Results: Proband vs. Control Adults

Variable: Years of education

($X^2 = 14.53$, p = .013)

Education	% of probands	% of controls
graduate degree	0	4
4-year college degree	0	7
partial college	8	43
vocational (> 1 year)	21	21
high school or equiv.	71	25

Figure 7

Outcome Results: Proband vs. Control Adults

Variable: Occupational status

($X^2 = 26.91$, $p < .0001$)

Hollingshead classes	% of probands	% of controls
major, minor professional	4	21
semiprofessional; sales; clerical	8	57
skilled manual; craftsmen	38	21
unskilled; unemployed	50	0

Figure 8

Results: Proband vs. Control Offspring

Domain: Articulation

Ages: 3-9 ($F = 6.00$, $p = .018$, effect size = .46)

	N	Mean T-score	SD
probands	24	48.64	8.35
controls	32	53.24	5.67

Ages: 9-15 ($X^2 = 3.86$, $p < .05$)

	N	Mean raw score	SD	% Fail*
probands	18	72.78	9.35	33
controls	9	77.78	4.41	0

*fail = score of 76 or less on 78-item TDAT

Test Results: Proband vs. Control Offspring

Domain: Language

(F = 4.87, p = .001, effect size = .86)

	N	Mean T-score	SD
probands	42	46.59	9.05
controls	41	55.20	6.91

Domain: Performance

(F = 5.56, p = .006, effect size = .59)

	N	Mean T-score	SD
probands	37	50.90	7.57
controls	35	56.76	8.23

Conclusions

In comparison to adults with good childhood articulation skills, adults with a history of childhood articulation disorder

- **demonstrate residual deficits in articulation and language functioning**
- **complete less formal education**
- **tend to occupy jobs which are considered unskilled**

Having a parent with a childhood history of articulation disorder greatly increases offspring risk for communicative impairments. In comparison to the offspring of control adults, the offspring of proband adults

- **perform more poorly on articulation, language, and performance tasks**
- **are at least 12 times more likely to receive articulation therapy**